APPENDIX B
BACKGROUND INFORMATION ON GROUNDWATER CHARACTERIZATION AND MONITORING

September 2004

HDMSe00013989

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ABBREVIATIONS

APTF	Advanced Propulsion Test Facility
bgs	below ground surface
COPC	chemical of potential concern
DTSC	Department of Toxic Substances Control
IEL	Instrument and Equipment Laboratory
LETF	Laser Engineering Test Facility
LUFT	Leaking Underground Fuel Tank
RWQCB	Regional Water Quality Control Board
SAP	sampling and analysis plan
SVOCs	semi-volatile organic compounds
VOCs	volatile organic compounds

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B 1.0 CHRONOLOGICAL DEVELOPMENT OF GROUNDWATER CHARACTERIZATION WORK IN THE NORTHEAST

The first groundwater characterization wells in the northeast were installed in 1985 and consisted of wells RS-1, -2 and -3, which were intended to evaluate the potential occurrence of volatile organic compounds (VOCs) in shallow target areas. Well locations are shown on Figure B-1. All three wells are screened in the near-surface groundwater system. Off-site wells OS-15 and -16, and spring OS-13, were inventoried and incorporated into the groundwater monitoring and sampling program.

In 1986, wells ES-11 and ES-12 were installed in near-surface groundwater to characterize groundwater in the Laser Engineering Test Facility (LETF) area and RD-1 was installed in the Chatsworth formation to characterize potential groundwater impacts associated with the Canyon test stands.

Near-surface groundwater monitoring wells HAR-2, -3 and -4 and Chatsworth formation wells HAR-1, -16, -24 and -25 were installed in 1987 to characterize groundwater adjacent to the Advanced Propulsion Test Facility (APTF) surface impoundments. This work was completed under the direction of the Los Angeles Regional Water Quality Control Board (RWQCB) in response to the Toxic Pits Clean-up Act and to fulfill the requirements of a Hydrogeologic Assessment Report for two surface impoundments at the APTF.

In 1989, Chatsworth formation well RD-31 was installed at the eastern edge of operations at the Instrument and Equipment Laboratory (IEL) to characterize the occurrence and concentration of VOCs.

In 1991, four shallow zone wells (RS-30, -31, -32 and -33) and one Chatsworth formation well (RD-53) were installed to characterize potential groundwater impacts associated with the removal/closure of underground storage tanks UT-39, -40 and -41 (see Appendix

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A). These tanks contained petroleum hydrocarbons near Building 351 at the B-1 Test Area.

In 1992, off-site wells OS-24, -25 and -26 were added to the groundwater monitoring and sampling program. These wells were installed by Sage Ranch in 1987. A plan was submitted to Department of Toxic Substances Control (DTSC) for the installation of 14 wells in the northeast investigation area to characterize the lateral and vertical distribution of VOCs in the Chatsworth formation groundwater (Groundwater Resources Consultants, Inc. [GRC], 1992).

Chatsworth formation wells RD-35A and RD-45A were installed in 1993 to characterize groundwater for the occurrence and concentration of VOCs within the IEL and adjacent to the LETF, respectively.

Twelve Chatsworth formation groundwater monitoring wells were installed in 1994 to characterize the lateral and vertical impacts of VOCs to groundwater. Wells that were installed included RD-32, -36A, -36B, -36C, -37, -38A, -39A, -43A, -43B, -43C, -45B, and -45C.

In 1995, Chatsworth formation well RD-73 was installed near the IEL to characterize groundwater near a release that was discharged to an excavation created to remove and install underground storage tanks (UT-37/38, see Appendix A) near Building 324. A work plan was also submitted to DTSC to further characterize groundwater conditions in the northeast investigation area (GRC, 1995c).

In 1997, Chatsworth formation wells RD-66 and RD-71 were installed off-site. Installation of Chatsworth formation wells RD-36D and RD-39B was initiated. The groundwater advisory panel was retained by Rocketdyne. The panel consisted to Drs. John Cherry and Beth Parker from the University of Waterloo and Dr. David McWhorter from Colorado State University. Rock coring and special VOC core sampling and analysis were also initiated at well RD-35B in late 1997 at the direction of the advisory

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panel. A pilot test of groundwater extraction was initiated in 1997 at Chatsworth formation well RD-73.

In 1998, the installation of Chatsworth formation wells RD-36D and -39B was completed and Chatsworth formation well RD-38A was installed. Off-site well OS-27 was added to the groundwater monitoring program. A temporary multi-level system was deployed in corehole RD-35B to collect depth-discrete groundwater samples and for measuring hydraulic head. Straddle packer and advanced borehole geophysics testing were also performed in at this location. The United States Geological Survey performed the advance borehole geophysics work.

Chatsworth formation well RD-35B was completed in early 1999.

In 2000, a Technical Memorandum titled Conceptual Site Model, Movement of TCE in the Chatsworth Formation (Montgomery Watson, 2000a) was submitted to the DTSC. The shallow zone groundwater and CFOU characterization work plans were also submitted (Ogden, 2000, Montgomery Watson, 2000b). Coring and sampling of bedrock at coreholes C-1 and C-3 was initiated in late 2000. Two near-surface groundwater piezometers were installed in the late fall of 2000 (PZ-003, PZ-008).

Sixteen near-surface groundwater piezometers were installed in the early spring of 2001 (PZ-011, PZ-063, PZ-064, PZ-065, PZ-066, PZ-067, PZ-068, PZ-069, PZ-075, PZ-081, PZ-083, PZ-086, PZ-088, PZ-089, PZ-092, and PZ-094). Two additional near-surface groundwater piezometers were added within the northeast investigation area in late 2001 (PZ-118 and PZ-119). A pumping test was performed at RD-35B to obtain estimates of hydraulic conductivity. Fourteen existing wells were retrofitted with multi-level monitoring systems.

In 2002, corehole C-1 was deepened from a depth below ground surface (bgs) of 400 feet to 600 feet. Step-drawdown tests were performed in C-1 in June and October of 2002.

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The multi-level monitoring systems that were installed into existing wells in 2001 were sampled for chemicals of potential concern (COPCs).

In late 2003, three additional wells were installed within the northeast investigation area as part of the Perchlorate Characterization Work Plan (RD-77, RD-78 and RD-84). Wells RD-77 and RD-84 were continuously cored and sampled at approximately one-foot intervals for perchlorate and VOCs, respectively (MWH 2003, Haley & Aldrich, 2004).

A pumping test was performed at corehole C-1 between August 2003 and January 2004. After completion of the pumping test, a water level recovery test was performed through early June 2004. Water levels were measured in 21 nearby wells during pumping and recovery.

B 2.0 OVERVIEW OF CURRENT GROUNDWATER MONITORING PROGRAM

Specific groundwater monitoring and sampling requirements at the SSFL include detection monitoring, evaluation monitoring and interim corrective action monitoring as described in the Post-Closure Permit, and the requirements of Title 22, California Code of Regulations (CCR), sections 66264.97 through 66264.99. Periodic monitoring and sampling activities include:

- Measuring static water levels
- Collecting groundwater samples and submittal for laboratory analysis, and
- Quarterly reporting of measurements, results and interpretations.

Monitoring wells are sampled quarterly, semi-annually, or annually in accordance with the current Sampling and Analysis Plan (SAP) for the site (GRC, 1995a, 1995b). Per the groundwater monitoring program, groundwater samples are collected quarterly from both near-surface and Chatsworth formation wells, and selected off-site wells and springs.

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The current overall sampling and analysis program for wells located in the northeast is summarized in Table B-1.

Target analyte groups in the northeast area include: VOCs, fuel hydrocarbons, trace metals, inorganic constituents, semi-volatile organic compounds (SVOCs), and perchlorate. Inorganic constituents include major cations (calcium, magnesium, potassium, and sodium), major anions (bicarbonate, carbonate, chloride, fluoride, nitrate, and sulfate), total and dissolved iron, total dissolved solids, pH, and specific conductance. As part of the CFOU groundwater investigation, a number of wells were monitored for constituents of concern, the list of which is defined in the Post-Closure Permit.

B 2.1 Near-Surface Groundwater Sampling

Wells RS-01, RS-30, RS-31, and RS-32 are sampled semi-annually as part of the Leaking Underground Fuel Tank (LUFT) program. Well RS-01 is also sampled semi-annually as part of the evaluation monitoring program (which also includes HAR-03). Wells ES-11 and HAR-04 are sampled semi-annually as part of the interim corrective action program.

B 2.2 Chatsworth Formation Groundwater Sampling

Chatsworth formation detection monitoring and background wells RD-32, RD-37, RD-39A, RD-43A, RD-43B and RD-43C are sampled quarterly. Chatsworth formation evaluation monitoring wells RD-10, RD-36A, RD-36B, RD-36C, RD-38A, RD-45A, RD-45B and RD-45C are sampled semi-annually as part of the evaluation monitoring program. Well RD-1 is part of the interim corrective action program and is sampled quarterly. Chatsworth formation perimeter wells RD-39B, RD-66 and RD-71, which are located off-site near the SSFL, are also sampled quarterly. Chatsworth formation wells RD-32, RD-36A, RD-36B, RD-36C, RD-36D, RD-37, RD-38A, RD-38B and RD-53 are also part of the LUFT monitoring program (sampled semi-annually also). Chatsworth formation point of compliance well HAR-16 is sampled for Appendix IX constituents annually.

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Wells RD-1 and RD-10 have also been sampled quarterly since the fall of 2000 for constituents of concern. This was done as part of the cessation of groundwater extraction from RD-1 in October 2000 for the Chatsworth formation groundwater characterization program. Finally, a number of off-site wells in the northeast were proposed for periodic sampling and analysis for perchlorate as outlined in the Perchlorate Characterization Work Plan (MWH, 2003).

B 3.0 GROUNDWATER USES DESIGNATED IN THE LARWQCB BASIN PLAN

Groundwater underlying the SSFL is not specifically designated for any particular or specific use according to the Basin Plan (RWQCB, 1994). Regional groundwater basins are located both to the north (Simi Valley) and to the southeast (San Fernando Valley) of the SSFL, as depicted on Figure B-2. As noted in the Basin Plan, existing beneficial groundwater uses for the Simi Valley and San Fernando Basins include municipal, industrial service supply, industrial process supply and agriculture.

B 4.0 REFERENCES

Groundwater Resources Consultants (GRC), Inc., 1992. Proposed Interim Well Construction Plan, Santa Susana Field Laboratory, Ventura County, California. May 5, revised August 17.

GRC, 1995a. Sampling and Analysis Plan, Hazardous Waste Facility Post-Closure Permit PC-94/95-3-02, Area II, Santa Susana Field Laboratory. June 5.

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GRC, 1995c. Proposed Designs and Methods for Drilling, Construction and Testing of Additional Monitor Wells at the Rockwell International Corporation, Rockeydne Division, Santa Susana Field Laboratory, Ventura County, California. July 26.

Haley & Aldrich, 2004. Memorandum, Completion and Groundwater Sampling of Well RD-84, Santa Susana Field Laboratory. May 12.

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MWH, 2003. Perchlorate Characterization Work Plan, Revision 1, Santa Susana Field Laboratory, Ventura County, CA. December.

Ogden, 2000. RCRA Facility Investigation, Shallow Zone Groundwater Investigation Work Plan, Final. Santa Susana Field Laboratory, Ventura County, California, December.

Regional Water Quality Control Board (RWQCB), 1994. Water Quality Control Plan, Los Angeles Region, Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties. June.

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Table B-1
Current Groundwater Monitoring Sampling and Analysis Program (2004)
Northeast Investigation Area
Santa Susana Field Laboratory

		ANALYTICAL METHODS				
Well ID	**Area**	**First Quarter**	**Second Quarter**	**Third Quarter**	**Fourth Quarter**	**Existing Sampling Plan**
SHALLOW WELLS						
RS-1	I	8260 8015 Perchlorate		8260 8015		Evaluation monitoring B/351
RS-2	I	Perchlorate				
RS-30	I	8260 8015 Perchlorate		8260 8015		B/351
RS-31	I	8260 8015		8260 8015		B/351
RS-32	I	8260 8015		8260 8015		B/351
ES-11	I	8260		8260		Interim corrective action
ES-12	I	8260 Perchlorate				
HAR-2	I	None				
HAR-3	I	8260		8260		Evaluation monitoring
HAR-4	I	8260		8260		Interim corrective action
CHATSWORTH FORMATION WELLS						
RD-1	I	COCs Perchlorate	COCs Perchlorate	COCs Perchlorate	COCs Perchlorate	Interim corrective action CFOU investigation
RD-10	I	COCs Perchlorate	COCs Perchlorate	COCs Perchlorate	COCs Perchlorate	Evaluation monitoring FLUTe sampling system CFOU investigation
RD-31	I	8260 Perchlorate				FLUTe sampling system
RD-32	Off-site, NE of	8260 8015	8260	8260 8015	8260	Detection monitoring B/351
RD-35A	I	8260				
RD-35B	I	8260				
RD-36A	Off-site, NE of Area I	8260 8015		8260 8015		Evaluation monitoring B/351
RD-36B	Off-site, NE of Area I	8260 8015		8260 8015		Evaluation monitoring B/351
RD-36C	Off-site, NE of Area I	8260 8015		8260 8015		Evaluation monitoring B/351
RD-36D	Off-site, NE of Area I	8260 8015		8260 8015		B/351
RD-37	Off-site, NE of Area I	8260 8015	8260	8260 8015	8260	Detection monitoring B/351
RD-38A	Off-site, NE of Area I	8260 8015		8260 8015		Evaluation monitoring B/351
RD-38B	Off-site, NE of Area I	8260 8015	8260	8260 8015	8260	B/351
RD-39A	Off-site, NE of Area I	8260	8260	8260	8260	Detection monitoring
RD-39B	Off-site, NE of Area I	8260	8260	8260	8260	Perimeter well

Source: Haley & Aldrich, Inc. June 2004

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Table B-1
Current Groundwater Monitoring Sampling and Analysis Program (2004)
Northeast Investigation Area
Santa Susana Field Laboratory

		ANALYTICAL METHODS				
Well ID	**Area**	**First Quarter**	**Second Quarter**	**Third Quarter**	**Fourth Quarter**	**Existing Sampling Plan**
RD-43A	Off-site, Near Area I	8260 Perchlorate	8260	8260	8260	Detection monitoring
RD-43B	Off-site, Near Area I	8260 Perchlorate	8260	8260	8260	Detection monitoring
RD-43C	Off-site, Near Area I	8260 Perchlorate	8260	8260	8260	Detection monitoring
RD-45A	I	8260		8260		Evaluation monitoring
RD-45B	I	8260		8260		Evaluation monitoring
RD-45C	I	8260		8260		Evaluation monitoring
RD-53	I	8260 8015 Perchlorate		8260 8015		B/351 FLUTe sampling system
RD-66	Off-site, NE of Area I	8260	8260	8260	8260	Perimeter well
RD-71	Off-site, NE of Area I	8260	8260	8260	8260	Perimeter well
RD-72	I	8260				FLUTe sampling system
RD-73	I	8260 8015 Perchlorate				UT 37 FLUTe sampling system
HAR-1	I	Perchlorate				FLUTe sampling system
HAR-16	I		App IX		8260	Point of compliance FLUTe sampling system
HAR-24	I	8260		8260		Evaluation monitoring FLUTe sampling system
HAR-25	I	8260 Perchlorate				
WS-14	I					
OFF-SITE OS WELLS AND SPRINGS						
OS-13	Off-Site	8260 Perchlorate		8260		
OS-16	Off-Site	8260 Perchlorate		8260 Perchlorate		
OS-24	Off-Site	8260		8260		FLUTe sampling system

Source: Haley & Aldrich, Inc. June 2004

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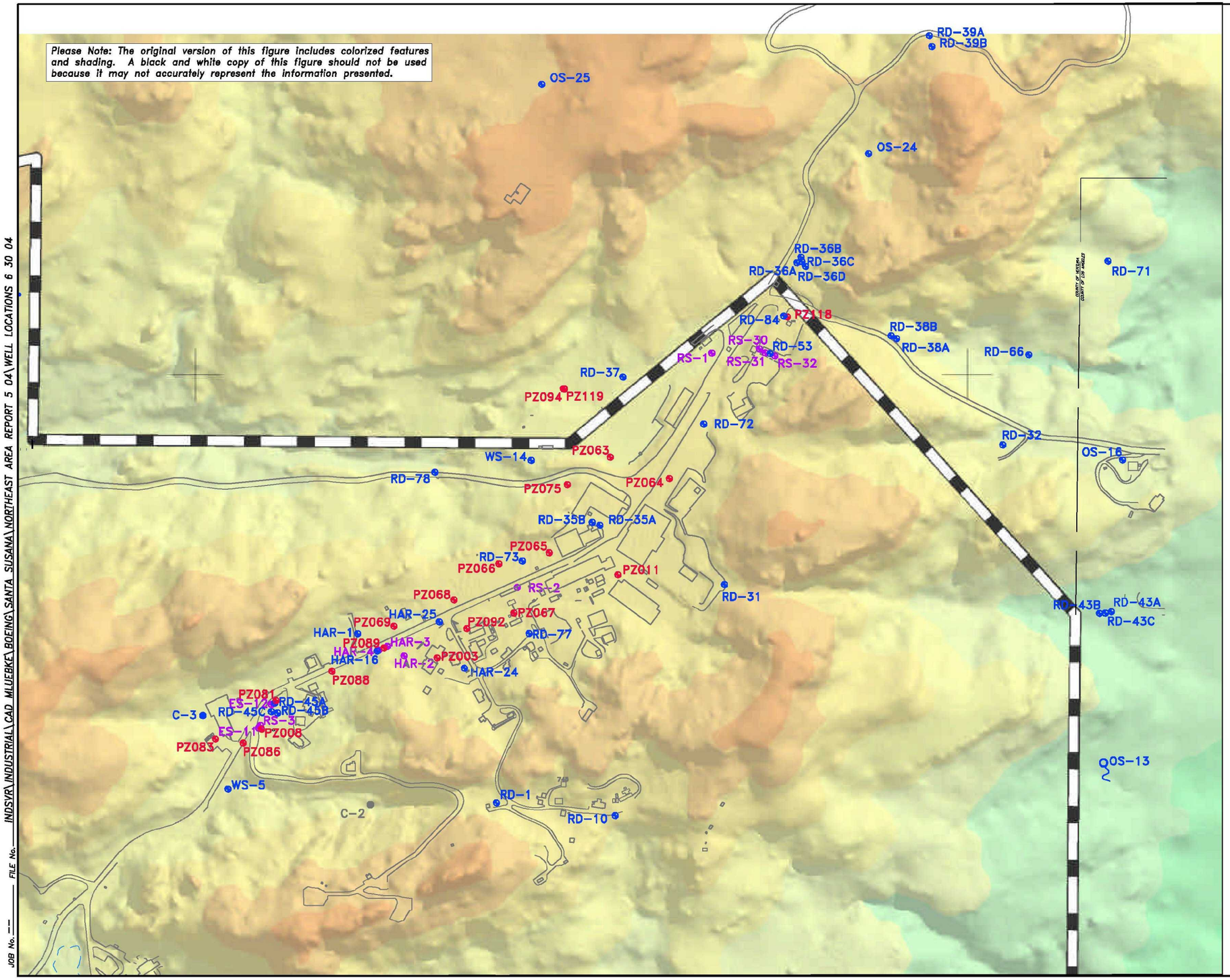
Please Note: The original version of this figure includes colorized features and shading. A black and white copy of this figure should not be used because it may not accurately represent the information presented.



LEGEND

● RD-29	CHATSWORTH FORMATION GROUNDWATER MONITORING WELL
● C-4	COREHOLE LOCATION
∿○ OS-12	SPRING LOCATION
⊕ RS-27	NEAR-SURFACE GROUNDWATER MONITORING WELL
⊕ PZ075	NEAR-SURFACE GROUNDWATER PIEZOMETER

NOTE:

ROCK CORE SAMPLING HAS BEEN PERFORMED AT THE FOLLOWING LOCATIONS:

- RD-35B (1997)
- C-1 (2000, 2001)
- C-3 (2000)
- RD-84 (2003)

} FOR VOCs

- RD-77
- RD-78

} FOR PERCHLORATE

CORE HAS ALSO BEEN COLLECTED FROM C-2 AND ANALYZED FOR VOCs, BUT THIS LOCATION LIES OUTSIDE OF THE STUDY AREA BOUNDARY.

N

0 FEET 500
SCALE

MWH

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VENTURA COUNTY, CALIFORNIA
SEPTEMBER 2004

LOCATIONS OF PIEZOMETERS, WELLS AND COREHOLES IN THE NORTHEAST INVESTIGATION AREA

FIGURE B-1

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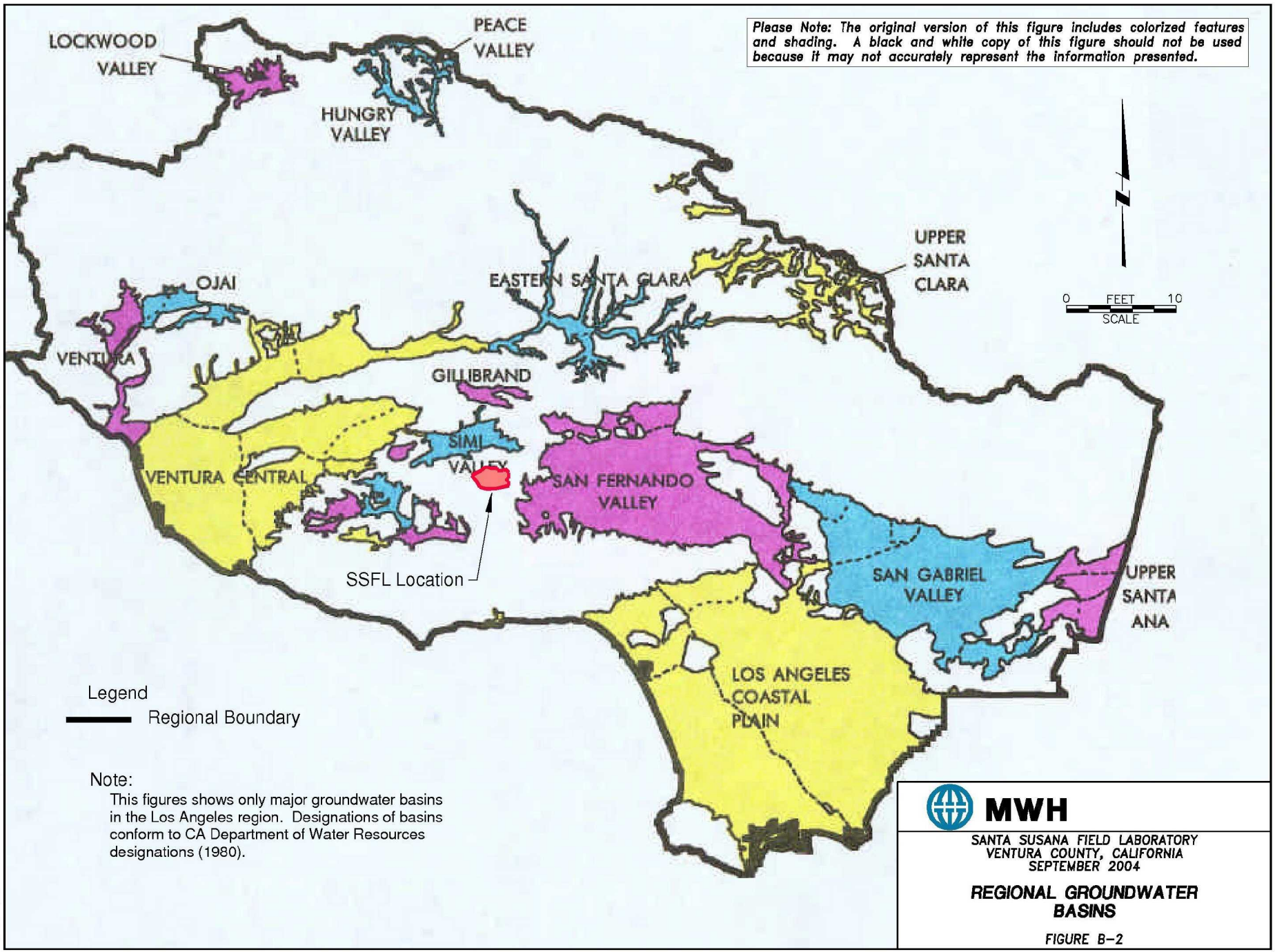
Please Note: The original version of this figure includes colorized features and shading. A black and white copy of this figure should not be used because it may not accurately represent the information presented.
LOCKWOOD VALLEY
PEACE VALLEY
HUNGRY VALLEY
UPPER SANTA CLARA
EASTERN SANTA CLARA
OJAI
VENTURA
GILLIBRAND
SIMI VALLEY
VENTURA CENTRAL
SAN FERNANDO VALLEY
SSFL Location
SAN GABRIEL VALLEY
UPPER SANTA ANA
LOS ANGELES COASTAL PLAIN
0 FEET 10
SCALE
Legend
Regional Boundary
Note:
This figures shows only major groundwater basins in the Los Angeles region. Designations of basins conform to CA Department of Water Resources designations (1980).
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SEPTEMBER 2004
REGIONAL GROUNDWATER BASINS
FIGURE B-2
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